Host Country R&D Determinants of MNE Entry Strategy:

A Study of Ownership in the Automobile Industry

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ABSTRACT

We investigate how host country R&D influences ownership decisions made by technology-intensive multinational enterprises (MNEs) as they internationalize. We draw from institutional and resource based theories, as well as literature on agglomeration and clusters, and construct a unique dataset of 1324 foreign investments recorded by German automobile manufacturers between 2005 and 2012 for our empirical tests. We find that in host countries that are cluster-abundant there will be a greater likelihood that technology-intensive MNEs will adopt joint ventures over wholly-owned subsidiaries, and will more likely use a lower equity stake in any joint venture. We find partial support for the influence of other aspects of host country R&D, including innovation output and inward technology FDI. Various robustness tests and insights from selected cases provide further support. Importantly, findings demonstrate the importance of multi-dimensional characteristics of host country R&D over and above those such as market size, political stability and cultural distance that are more commonly utilized and discussed in the entry strategy literature. The findings have implications for host country policy as well as strategy-makers in MNEs seeking to compete on the basis of globalized R&D.

Key Words: MNE ownership decisions, patenting, clusters, technology transfer, automobile industry

1. Introduction

The internationalization of R&D by multinational enterprises (MNEs) has been taking place for over 40 years (Wortmann, 1990), and has continued relentlessly (OECD, 2007). MNEs have increasingly internationalized in order to be close to sources of R&D in host countries. Overseas subsidiaries of MNEs act as a vital link between host country R&D and MNE networks, allowing the MNE to update strategic assets through internationalization (Cantwell and Mudambi, 2005; Dunning, 2000). Industries such as pharmaceuticals, IT development, aerospace, and smart phones have become characterized by MNEs with vast, continually evolving global networks of R&D.

Given this phenomenon, the relationships between R&D characteristics of host countries and internationalization strategy of MNEs are important to understand. Berry, Guillén and Zhou (2010) touched on this in their discussion of distance measures in international business research, showing how knowledge distance (i.e., the difference between home and host country in terms of numbers of patents and scientific articles) has a significant impact on foreign market entry choice. Hennart (2009) argued that entry mode is determined by the need to bundle local complementary assets with MNE assets, acknowledging the role that host country R&D characteristics might have in MNE internationalization. Meyer et al. (2009) highlighted the connection between access to host country tacit and intangible knowledge and entry mode.

Unfortunately, the bulk of research on MNE entry strategy, and ownership decisions in particular, does not explicitly capture host country R&D and its various forms (Canabal and White, 2008). One stream of literature on host country R&D and MNE strategy implicitly assumes the internationalization / entry mode choice already has already been made, i.e., the MNE has already internationalized (e.g., Almeida and Phene, 2004; Frost, 2001). However, host country R&D matters pre-entry because it represents future-oriented technological opportunity for the MNE. It may not only attract technology-intensive MNEs to consider investing in the host country, it has the potential to determine *how* they invest in the country. While extensive research has looked at location advantages and disadvantages (Dunning, 1998, 2000), the vast body on ownership has tended to emphasize features such as market characteristics, legal barriers, cultural distance and country risk factors (e.g., Agarwal and Ramaswami, 1992; Canabal and White, 2008; Delios and Henisz, 2003; Hennart and Larimo, 1998; López-Duarte and Vidal-Suárez, 2013; Yiu and Makino, 2002). Furthermore, some research on MNE entry strategy focusses on variance in firm and industry characteristics, ignoring the potential that host country R&D may account for entry decisions (e.g., Brouthers and Hennart, 2007; Chen and Hennart, 2002; Dikova, and Van Witteloostuijn, 2007).

We believe there is a gap in the literature with respect to the links between host country R&D and MNE entry strategy. Host country R&D is particularly relevant for technology-intensive MNEs that are 'on the look-out' for R&D capabilities and technological opportunities in host countries. For technology-intensive MNEs, host country attractiveness is not just about market size and various sources of non-commercial risk, it also relates to R&D opportunities. Following their extensive literature review on entry strategy research, Ahsan and Musteen (2011) called for more research on the effect of host country attractiveness on entry strategy. We believe this should extend to upstream features of host countries, as well as the demand-side. Also, there have been calls for entry strategy research to consider the role played by local complementary assets (Hennart, 2009) and for more research on entry strategy using specific industry samples (Brouthers and Hennart, 2007).

We address this research gap by examining the links between three dimensions of host country R&D and ownership decisions (mode and equity level). These dimensions are host country innovation output (captured through patenting, an indication of the health of the country's national innovation system), the extent of clusters and R&D collaboration in the host country (an indication of its policy towards agglomeration and related institutions for economic development through proximity and networks), and inward technology FDI (an indicator of whether the host country seeks to receive and absorb technology through internationally transferable resources). Drawing on institutional and resource-based theories we develop hypotheses for the effects of these determinants. Empirical tests using data on 1324 foreign investments made by technology-intensive German automobile manufacturers in 65 countries reveal: (1) host country R&D determinants are an important predictor of ownership decisions adopted by technology-intensive MNEs in their internationalization; (2) host country R&D determinants are more important for these types of companies than market size, political stability and cultural distance, which are commonly used independent variables in the entry strategy literature; (3) clustering is the most consistent host country R&D determinant, although innovation output and inward tech FDI play a role; (4) as JVs are defined at higher equity thresholds, the effects for host country clustering and inward technology FDI become stronger; (5) different aspects of a host country's R&D environment have different impacts on MNE entry strategy.

Our study makes three important contributions. Firstly, we add to the literature on host country R&D determinants of entry strategy by technology-intensive MNEs. We show the importance of clustering over innovation output and inward technology FDI as a factor encouraging inward investors to opt for a JV and lower equity stakes within JVs. Secondly, we show how institutional and resource-based explanations of this phenomenon are relevant to explaining entry strategy of technology-intensive MNEs. This suggests technology-intensive MNEs are more concerned about legitimacy and knowledge seeking imperatives than economizing on transaction costs as they expand abroad. Thirdly, we shed new light on internationalization patterns in the global automotive industry, an industry that had $105B of spending on R&D in 2014 (Strategy&, 2015) and one that accounted for 15.4% of global R&D spending in 2016[1]. We identify reasons why MNEs in the automotive industry seek JVs and lower equity stakes in foreign markets, despite the overarching tendency towards full control and higher equity stakes in foreign investments made by automotive companies possessing formidable firm-specific advantages (Pfaffmann and Stephan, 2001; Talay and Cavusgil, 2009; Yiu and Makino, 2002).

2. Understanding MNE ownership decisions

Early work on ownership drew largely from transaction cost and internalization theory and the need for firms to economize on transaction costs as they internationalize. More recently scholars have devoted considerable attention to alternative theoretical bases for understanding ownership (i.e., the choice between a wholly-owned subsidiary (WOS) and a joint venture (JV)) and the underlying equity stake in international markets, prominently institutional and resource-based theories (Brouthers and Hennart, 2007; Mani et al., 2007). Yiu and Makino (2002), for instance, built on institutional theory (DiMaggio and Powell, 1983; Scott, 1995) to argue that MNE ownership decisions can be seen as a response to isomorphic pressures in the external environment, as well as internal organizational practices and routines. Institutions provide the

[1] https://www.statista.com/statistics/270233/percentage-of-global-rundd-spending-by-industry/ accessed 10 July 2017

structure for investments to occur (North, 1990). This structure consists of regulative, normative (social obligations) and cognitive (collective constructions of social reality) dimensions (Scott, 1995). In this sense, institutions set “the rules of the game” through coercive, mimetic and normative mechanisms (DiMaggio and Powell, 1983; Rodriguez et al., 2005). They determine the degree of stability in society as well as the extent to which property rights are undermined (Brouthers, 2002). Williams et al. (2017) showed how institutions at supra-national level can also play a role in influencing levels of ownership adopted by MNEs in host countries. Such institutions not only provide a basis against which the MNE seeks legitimacy, they also provide “reassurance power” (Williams et al., 2017) that will help the MNE to overcome risk and uncertainty in the host country.

Institutional theory suggests that in countries where the institutional environment undermines confidence, businesses will seek a lesser degree of control (North, 1990). A weak institutional environment encompasses conditions that compromise property and contract rights, therefore increasing the investment hazards. When a country has a weak institutional environment, firms are less likely to commit because a greater degree of ownership implies greater responsibility and risks (Brouthers, 2002). Hence, the institutional environment has an impact on the suitability of governance structures. MNEs will waive full ownership for their subsidiaries abroad and prefer shared ownership to counteract their subjection to institutional hazard (Delios and Beamish, 1999; Gomes-Casseres, 1990). Henisz (2000) argued a more nuanced line in that MNEs will choose shared ownership when political hazards increase but will opt for full ownership as contractual hazards increase (i.e., possible opportunistic behaviour from local partners and/or host governments).

A further approach for understanding ownership in foreign markets revolves around resources, capabilities and knowledge. MNEs can exploit their assets in international markets, or can use international markets to augment these assets (Brouthers and Hennart, 2007). Mutinelli and Piscitello (1998) showed how MNEs opt for JVs over WOS when they need to complement in-house R&D resources. Drawing on Italian FDI data, these authors shone the spotlight on how a lack of specialized resources and capabilities in firms can be a motive for pursuing JVs in foreign markets. Such JVs help the investing firm to develop new technology and specialized capabilities. Research has also highlighted links between resource-based advantages of firms and the use of WOS mode (Brouthers and Hennart, 2007; Gomes-Casseres, 1990). Nonetheless, knowledge sourcing and learning remain a major motive for the internationalization of MNEs (Dunning, 2000; Kuemmerle, 1997), especially in knowledge-intensive industries where developing an R&D capability through overseas linkages with innovative companies and prominent knowledge centres such as universities and research institutions can be crucial to long-term performance (Iwasa and Odagiri, 2004).

3. Hypothesis development

These theoretical perspectives suggest specific areas of concern for technology-intensive MNEs: gaining legitimacy and responding to isomorphic pressure in institutional theory, and augmenting and exploiting assets in resource-based logic. We examine the relevance of these concerns as MNEs consider different dimensions of host country R&D during internationalization. A summary of the core arguments is given in Appendix A.

3.1 The host country as a generator of innovation

A technology-intensive MNE can be attracted to invest in a country because it sees the country as a generator of innovation. However, countries vary considerably in terms of their capacities to generate innovation. Innovation output, often assessed in terms of patenting productivity, is associated with sophisticated and high grade technological activity taking place in a country (Athreye and Cantwell, 2007; Frost, 2001). The occurrence of this activity will appeal to technology-intensive MNEs seeking to tap into globalized R&D.

In terms of formal institutions, countries that are large scale generators of innovation are likely to have strong and stable institutional profiles both in terms of political and regulatory environments (Waguespack et al., 2005). Such countries will have a highly regarded protection regime for intellectual property rights and investors will be able to trust in the governance infrastructure of the country in case those rights are not respected. This institutional quality of the host country can influence ownership decisions. In Dikova and van Witteloostuijn's (2007) study, for instance, JVs were seen as more preferable over WOS in countries with high levels of institutional advancement (i.e., high levels of governance quality).

In terms of isomorphic pressure in institutional theory (DiMaggio and Powell, 1983), there is unlikely to be regulative pressure to choose a specific ownership mode in connection with levels of patenting in the country. However, there may be cognitive or normative pressure for the MNE to engage in exploring new technologies in the host country and to become involved in the generation of innovations in the host country. Castellani and Zanfei (2002) briefly mentioned this as a possible factor that could explain gradual involvement of MNEs in creative activities in host countries (Castellani and Zanfei, 2002: 6). Yiu and Makino (2002) demonstrated empirically a link between isomorphic pressures and levels of ownership. MNEs will be more likely to seek legitimacy within the R&D environment of an innovation-productive host country by making lower equity stakes in JVs. These will demonstrate a willingness to explore new early stage technologies with partners (Dittrich et al., 2007) over a fully controlled WOS that is designed to exploit firm specific advantages and buffer against contextual risk (Yiu and Makino, 2002). What matters from an institutional perspective is the need to establish legitimacy in the R&D environment of the country.

From a resource-based perspective, high innovation output in a host country is seen as an indicator of high grade intangible assets and national competence in R&D. Foreign MNEs in technology-intensive industries increasingly need to tap into innovative capabilities wherever they may be in the world, they are not necessarily assumed to originate from a home country (Cantwell and Mudambi, 2005, 2011; Kuemmerle, 1999; Meyer et al., 2009). Host countries that are highly productive in patenting will possess locational factors conducive to MNEs pursuing competence-creating mandates (Cantwell and Mudambi, 2005). In March's (1991) terms, such subsidiaries will pursue explorative activities, augmenting home-based assets (Kuemmerle, 1999). According to March (1991), an exploring enterprise is one that seeks to discover new possibilities, takes on risk, and which needs to be flexible. JVs provide the structural answer to this flexibility (Dittrich et al., 2007). Exploitation, on the other hand, is aligned with competence-exploiting mandates - achieving efficiency, production, implementation and execution. Exploration is conducive to partnerships between firms from different business areas – this providing diversity in the actors involved in the innovation process and access to previously unknown knowledge and resources.

Hypothesis 1:

The greater the innovation output of a host country, the more likely a technology-intensive foreign MNE will (a) choose a JV over a WOS, and (b) will use a lower equity stake in any JV in the host country.

3.2 The host country as a domain for clustering and R&D collaboration

A technology-intensive MNE may also consider a host country because of the state of development of its industrial clusters, i.e., concentrations of infrastructure and organizations arising through a process of agglomeration over time. This concentration can act as an inducement for MNEs to invest. Through collaborative linkages with other firms within a cluster, MNEs can benefit from spillovers, gaining knowledge and accessing specialized labor markets (De Propris and Driffield, 2006; Porter, 2000). The physical proximity promotes learning and innovation as communication becomes extensive. In certain industries - including the automotive industry - product architecture means that a change in one component will lead to changes in others (Sturgeon et al., 2008). Participating in clusters allows coordination of changes to happen quickly and efficiently. MNEs also will be able to learn about the nature of local competition (Saxenian, 1994).

From an institutional theory perspective, government policy will have a role to play in the development of advanced clusters in a host country. In this view, an MNE's ownership decision is a response to isomorphic pressures in the external environment, including regulative aspects (DiMaggio and Powell, 1983; Scott, 1995). MNEs yield to coercive pressures (Rodriguez et al., 2005) to conform and align to host country policy with respect to clusters. Porter (2000) referred to the importance for governments to continually upgrade clusters, "removing obstacles, relaxing constraints, and eliminating inefficiencies that impede productivity and innovation in the cluster" (Porter, 2000: 26), and in so doing becoming "magnets for attracting foreign investment" (Porter, 2000: 16). Given this core aim of government policy to establish and nurture clusters within its national borders (Casper, 2007), such cluster upgrading policy will be apparent to MNEs considering investment in the country. Beyond regulative institutions, Casper (2007) showed the importance of social networks linking managers across organizations within clusters. This suggests normative institutions will encourage investing MNEs to seek network advantages using lower equity stakes. In other words, MNEs will be attentive to the norm that JVs will support complementarities, alignment of activities and coordination between members (Porter, 2000).

While the flow of geographically localized knowledge facilitates the growth of technologically specialized regions, scholars also have pointed out how firms in clusters may develop 'pipelines' with other non-local clusters and institutions in other countries (Bathelt et al., 2004). Clusters can therefore have an 'outward looking' dimension with knowledge and resources flowing locally through ongoing informal personal interactions as well across clusters (Bathelt et al., 2004). Understanding the "different institutional regimes" (Bathelt et al., 2004: 43) in different parts of the world where pipelines between clusters are connected will be a concern for an inwardly investing MNE. Using a lower equity stake and working with partners will allow the MNE to negotiate the complexity of this and to "develop a joint interpretive context in order to engage in interaction" (Bathelt et al., 2004: 43). From a resource-based perspective, we believe it is more likely the MNE will use a JV in host countries characterized by advanced cluster development and R&D collaborations in order to engage in knowledge and resource co-creation in both local cluster (e.g., Jaffe et al., 1993) and through these pipelines that clusters will inevitably form with other clusters in the world (Bathelt et al., 2004).

Hypothesis 2:

The greater the extent of well-developed clusters and R&D collaborations in a host country, the more likely a technology-intensive foreign MNE will (a) choose a JV over a WOS, and (b) will use a lower equity stake in any JV in the host country.

3.3 The host country as a recipient of inward technology FDI

A technology-intensive MNE considering making an investment in a host country will also be faced with the possibility that the host country receives inward technology FDI from other MNEs from other countries. This can be as a direct consequence of the host country's policies, particularly its demand-pull policies (Fabrizio et al., 2017). This increases the competitive threats facing the MNE in the host country and brings into sharp focus its need to protect its innovative assets as they are deployed to that country.

From an institutional theory perspective, a question arises relating to the legitimacy of a given MNE's strategy in the country. Mimetic and normative isomorphic pressures to conform to what is acceptable in terms of inward FDI will be present. An MNE will consider it necessary to seek legitimacy in the host country by also pursuing a strategy in which the MNE brings its proprietary technology into the country. While the emphasis here may be on gaining influence over host country actors and securing long standing relationships and acceptance into the institutional environment of the host country, the MNE will nevertheless need to ensure that it has control of this process. A fully-controlled investment will allow technology to be transferred in an ordered manner consistent with the MNE's overall strategy for asset protection.

From a resource-based perspective, technology being transferred into a host country by other MNEs from other home countries may be considered a threat. A question arises for a given MNE regarding how to deal with this threat using its own assets, capabilities and know-how. It is more likely the MNE will need to transfer its own assets from other parts of its global organization in order to defend against the threat implied by other MNEs transferring their technology into the host country. Kogut and Zander's (1993) seminal work showed the less codifiable (and therefore more difficult to transfer) the knowledge, the more likely the knowledge will be transferred within the MNE using a WOS. Others have shown MNE proprietary assets to be linked with greater equity stakes (e.g., Mani et al., 2007). When the host country becomes a battle ground for competing MNE assets, a WOS can act as a competitive weapon, allowing proprietary knowledge to be deployed to the host country in a controlled way. Using a lower equity share (especially a minority stake) presents commercial risk in this line of thinking. Proprietary assets and technology can be lost through subtle forms of intellectual property (IP) infringement with partners eager to build their own asset bases. The MNE will be able to control its assets better through higher equity stakes (Brouthers and Hennart, 2007), and this will be useful if the MNE needs to re-allocate resources to the subsidiary as and when required given competitive moves by other MNEs. Furthermore, the MNE will be able to control its internal knowledge network more effectively when these are fully internalized through a WOS (Kogut and Zander, 1993).

Hypothesis 3:

The greater the extent that the host country is a recipient of technology through FDI, the more likely a technology-intensive foreign MNE will (a) choose a WOS over a JV, and (b) will use a higher equity stake in any JV in the host country.

4. Methodology

The sample were foreign direct investments made by MNEs in the automobile manufacturing industry listed on the Deutscher Aktienindex (DAX – German Stock Index) between 2005 and 2012. The parent companies were BMW, Daimler and Volkswagen. While Germany's economy is the largest in Europe and fourth largest by GDP in the world (Forbes, 2015), Germany was the fifth largest outward investing economy in the world (OECD, 2013).

The automotive industry is particularly relevant for our study as it contains technology-intensive firms, many of which are highly globalized. Commentators have observed how (1) global R&D spending in this industry increased from $70B in 2005 to $105B in 2014; (2) cars have become extremely high-tech, and R&D assets are needed for continuous product enhancements in transmission, fuel cells, sensors, entertainment, communication, advanced driver assistance systems (ADAS) and autonomous driving; (3) the industry has experienced improved innovation performance – with new product and service ideas meeting commercial goals (Strategy&, 2015). The automotive industry has been used in empirical studies in internationalization strategy in prior research (Belis-Bergouignan et al., 2000; Pfaffmann and Stephan, 2001; Yiu and Makino, 2002). Belis-Bergouignan et al. (2000) found European automobile manufacturers, including VW, to adopt strong hierarchical control, and singled out VW as a company seeking to become integrated on a world-wide basis. Similarly, Sturgeon et al. (2008) noted how the automotive industry historically had been vertically-integrated. Correspondingly, Yiu and Makino's (2002) automobile sub-sample had a high percentage of fully owned (high control) investments.

German regulations require stock-listed companies to issue a list of investments (Anteilsbesitzliste) annually, providing information on all material subsidiaries of the company. Using this list and cross-checking it with prior years, we hand-captured all new foreign entries of BMW, Daimler and Volkswagen in the eight years from 2005 through 2012, i.e., before and after the financial crisis. Scholars previously have used this list as a reliable source of data on FDI and MNE entry strategy (e.g., Hutzschenreuter et al., 2014; Schanz et al., 2017). We also reviewed the annual reports for these companies scanning for keywords such as "acquisition", "investment", "joint venture", in order to ensure that no investments were missed or misinterpreted. After removing some observations due to missing values on certain variables of interest, the final sample size was n=1324, corresponding to an average of 165.5 new foreign investments per year.[2] These 1324 foreign direct investments covered 65 different countries. Tables 1 and 2 show the distribution of observations and characteristics of the MNEs, as well as the host countries in the sample according to their OECD membership. As indicated by Table 1, the R&D investments and patenting by these MNEs indicates they are all highly technology-intensive, spending upwards of € 97.90 Billion collectively on R&D over the years of interest and filing upwards of 21,000 patents in that time. Table 2 shows a wide distribution of developing and developed countries in the sample.

Tables 1 and 2 about here

4.1 Operationalization and model

4.1.1 Dependent variables.

Firstly, we captured the main ownership decision using the widely-applied mode operationalization: WOS (=1) where there was an equity stake >= 95% and JV (=0) where there was an equity stake less than 95%. Various thresholds for the cut-off point between full and shared ownership are used in the literature, including 51% equity stake (Filatotchev et al., 2008), 80% (Dhanaraj and Beamish, 2004) and 90% (Demirbag et al., 2007; Dikova, and Van Witteloostuijn, 2007). Yiu and Makino (2002) ran tests at 80%, 95% and 100% levels. We employ a 95% cut off as this is most commonly used (Anderson and Gatignon, 1986; Chen and Hennart, 2002; Gomes-Casseres, 1990; Hennart and Larimo, 1998; Makino and Beamish, 1998; Mutinelli and Piscitello, 1998) but we also conducted robustness tests at other equity threshold

[2] The distribution of observations over the eight years was as follows (number of observations and percent of total sample in parenthesis): 2005 (n=29, 2.2%), 2006 (n=102, 7.7%), 2007 (n=132, 10.0%), 2008 (n=225, 17.0%), 2009 (n=59, 4.5%), 2010 (n=54, 4.1%), 2011 (n=551, 41.6%), 2012 (n=172, 13.0%).

levels (reported below). Secondly, we used the actual equity stake in additional tests to estimate effects on a continuous (right-censored) scale for JVs. The final dataset had 1185 observations classified as a WOS, and 139 classified as a JV. This distribution is expected with the large German automobile manufacturers in our sample and consistent with the argument that MNEs with high levels of technically sophisticated products and proprietary content will tend to choose a WOS in their overseas investments (Chen and Hennart, 2002; Delios and Henisz, 2003; Yiu and Makino, 2002). Indeed, in the 102 automotive companies in Yiu and Makino's (2002) study, the mean equity ownership for overseas investments was 82%. At the 80% threshold, only 21 of the 102 observations were classified as JVs. This is very consistent with what we see for BMW and Daimler in our sample, although the mean equity stake made by Volkswagen was higher and more consistent with the Nissan (90.5%) and Mitsubishi Motors (99.5%) observations in Yiu and Makino's (2000) study.

4.1.2. Independent variables.

We captured innovation output using host country patenting intensity; the total number of utility patents in each of the years, sourced from the World Intellectual Property Organization's (WIPO) IP database. We transformed this variable using a natural log due to its skewed distribution across countries (Table 2). For indicators of clustering / R&D collaboration and inward technology FDI we used items from the World Economic Forum's (WEF) Executive Opinion survey for each of the years in the data. This survey is reported as the Global Competitiveness Report (GCR) and covers the vast majority of countries. For clustering, we used item 11.03 from the block on business sophistication. This item refers to the state of cluster development and asks respondents to indicate "how widespread are well-developed and deep clusters (geographic concentrations of firms, suppliers, producers of related products and services, and specialized institutions in a particular field)?", with possible responses between 1 (non-existent) and 7 (widespread in many fields). For inward technology FDI, we used item 9.03 from the block on technological readiness. This item asks "To what extent does foreign direct investment (FDI) bring new technology into your country?", with responses between 1 (not at all) and 7 (to a great extent – FDI is a key source of new technology).

4.1.3 Control variables.

We used sixteen control variables. At the host-country level we controlled for: (1) market size, as this may indicate demand for a market-seeking MNE (Gomes-Casseres, 1990) and exploitation-oriented investments (Brouthers and Hennart, 2007); (2) economic development using the natural log of the country's GDP per capita in U.S. dollars and purchasing-power parity (Vaaler and Schrage, 2009); (3) levels of political hazard and uncertainty in the host country using Henisz' political constraints measure (a higher value indicating more veto points amongst the host country's executive and less political uncertainty) (Henisz, 2000); (4) cultural distance, given that this has been shown to be a source of risk that can impact ownership choices (Hennart and Larimo, 1998; López-Duarte and Vidal-Suárez, 2013). At firm level, we controlled for differences between the three parents using dichotomous dummy variables for each parent. Prior research on ownership has included year of establishment as a fixed effect (Mani et al., 2007). We also included year dichotomous dummies (eight year dummies). Pooling data across time and MNE in studies of ownership is not uncommon in the MNE entry strategy literature (e.g., Chen and Hennart, 2002; Delios and Beamish, 1999; López-Duarte and Vidal-Suárez, 2013; Mutinelli and Piscitello, 1998; Talay and Cavusgil, 2009; Williams et al., 2017). Finally, we controlled for prior recent experience of the MNE in the host country indicated by a separate investment by that MNE in that country in any given prior year in the time frame of the study

(Delios and Beamish, 1999). Again, this is commonly seen in studies on ownership mode and equity stake, accounting for the possibility that the ownership decision is in part determined by learning from previous FDI by the MNE into the host country (Mani et al., 2007; Williams et al., 2017). We used a dichotomous dummy variable for this. Table 3 shows all variables in terms of their definitions and measurement.

Table 3 about here

We applied a Breusch and Pagan Lagrangian multiplier test to assess the validity of using panel estimation. The result of the Chi-square test was not significant and we do not reject the null hypothesis that pooled analysis is appropriate. As commonly used in the entry strategy literature, we used a binary logistic regression to test hypotheses H1(a), H2(a) and H3(a). As the dependent variable was a dichotomous variable (WOS=1, JV=0), the probability of the MNE choosing a WOS over a JV is expressed as:

$$P(\mathrm{MODE} = \mathrm{WOS}) = \frac{1}{1 + e^{-t}}$$

where *t* is the linear function: $t = \alpha + x_i \beta$, and β represents the regression coefficients for control and independent variables described above. We also ran TOBIT models (e.g., Delios and Beamish, 1999) with equity stake right-censored at 95% as the dependent variable to test hypotheses H1(b), H2(b) and H3(b).

4.2 Quality and robustness tests

Firstly, for our main ownership mode tests we ensured the assumptions for binomial regression were not violated, namely that the dependent variable was dichotomous, independent variables were continuous or categorical (for year and company dummies), observations were independent and the dependent variable had mutually exclusive and exhaustive categories. We ran the Box-Tidwell (1962) test to test for linear relationship between continuous independent variables and ownership mode. This procedure entailed computing the natural log of each continuous predictor, and including interactions between each predictor and its natural log. None of these interactions were significant. Secondly, we checked the Hosmer–Lemeshow statistic for all binary logistic models and found in each case that Chi-square not significant ($p<0.05$). This supported a null hypothesis that observed and expected values were the same across all cases in each test. Thirdly, we examined the classification table for each logit model and found the percentage of cases correctly classified to range between 88% and 92%. These were very acceptable, being comparable or higher than those reported in prior ownership mode studies (Mutinelli and Piscitello, 1998). Fourthly, we ran models with the VW observations excluded. We did this because of *potential* bias in VW's investment strategy towards WOS linked to the company's emissions cheating software scandal. In 2015, VW had admitted they knowingly cheated emissions tests on their diesel vehicles by installing secretive "defeat devices", allowing the company to pass regulatory tests while actually emitting much higher levels of hazardous gases (Lynch, Cutro and Bird, 2016). Fifthly, we replaced the three main independent variables with alternative proxies. We used item 9.01 from the WEF's GCR report, availability of latest technologies as a proxy for innovation output of the host country. Item 12.04, university-industry collaboration in R&D was used as an alternative proxy for host country clustering and R&D collaborations. Item 9.02, which captures the extent to which host country businesses adopt new technology as a proxy for inward technology transfer, reflecting the absorption side of technology transfer within the host country. We also replaced the dependent variable with dichotomous ones capturing equity stake at 80% and greater (Dhanaraj and Beamish, 2004) and 51% and greater (Filatotchev et al., 2008) respectively. In each case, we ran models with all three of the main independent variables and all three of the alternative independent variables.

Finally, we collected additional secondary data to examine 9 of the investments (3 for each MNE at lower and higher levels of equity stake) in greater detail. We looked at investments in Kringlan (Switzerland), ParkatmyHouse (UK) and Sauber Aerodynamik (Switzerland) for BMW, Icelandic New Energy (Iceland), STARCAM (Czech Republic) and MB SIM Technology (China) for Daimler, and TTTech Computertechnik (Austria), Cummins-Scania high pressure injection (USA) and Mälardalens Teknikgymnasium (Sweden) for VW. In each case we identified the motive and opportunity for the investment and examined the extent to which evidence linked the case to our variables of interest.

5. Results

Table 4 shows descriptive statistics and bi-variate correlations among variables of interest. Results indicate the WOS choice to be negatively correlated with innovation output ($r=-0.16$, $p=0.001$) and clustering ($r=-0.14$, $p<0.001$), in line with our predictions. Figure 1 shows the distribution of cases grouped by ownership mode. The JV group has a tendency towards higher innovation output and clustering and the mean differences are positive and significant for these two groups. Cultural distance is negatively correlated with host country GDP per capita ($r=-0.44$, $p<0.001$), indicative of investments made by German automobile manufacturers in China, India and Indonesia that were culturally distant but still in economic transition (Table 2). This coefficient is very similar to that reported in Talay and Cavusgil (2009) who reported an $r=-0.466$ between cultural distance and GDP per capita on a sample of automotive firms' international investments. As expected, we see host country economic development to be positively correlated with cluster development ($r=0.52$, $p<0.001$). Innovation output is negatively correlated with inward technology FDI ($r=-0.11$, $p<0.001$), a possible indication of a host country's reliance on importing technology from foreign MNEs where the national innovation system is weak or emerging. As expected, we see POLCON to be positively correlated with economic development ($r=0.61$, $p<0.001$).

Table 4 about here

Figure 1 about here

In the main logistic regression models (Table 5), none of the control variables are consistently significant across all models. The weakness in the effect of cultural distance in our sample supports the absence of this effect in Talay and Cavusgil's (2009) study of IJV formation in the automobile industry. However, it contradicts the effects found in other ownership studies (e.g., Hennart and Larimo, 1998; López-Duarte and Vidal-Suárez, 2013). Predictions are partially supported for innovation output (H1(a)), fully supported for clustering (H2(a)), and partially supported for inward technology FDI (H3(a)). Innovation output has the anticipated negative sign but is only significant ($p<0.05$) in the VW-excluded model. The coefficient for clustering is negative and significant when entered separately and in the final model. It is also negative and significant for the VW-excluded model (Model 6) ($p<0.001$). Inward technology FDI is not significant when entered separately but is positive ($p<0.05$) in the final model. However, it drops out of significance for the VW-excluded model. The TOBIT analysis in Table 6 provides strong support to H2(b), with the coefficient being negative and significant throughout. Echoing the LOGIT models, there is only partial support for H1(b) and H3(b); signs are as predicted.

Robustness tests in Table 7 show availability of latest technologies and university – industry collaboration in R&D in host countries both give negative and significant coefficients, indicating preference for JV over WOS, when entered alone. University-industry collaboration in R&D is negative ($p<0.1$) for the VW-excluded model (Model 5 in Table 7). Similarly, the TOBIT analysis in Table 8 reveals negative coefficients for availability of latest technologies ($p<0.05$ in Model 1) and university – industry collaboration in R&D ($p<0.1$ in Model 5). For models with lower equity thresholds for ownership mode (Table 9), innovation output and clustering retain their negative signs, although clustering has a stronger coefficient and is consistently significant. Inward technology FDI increases the likelihood of WOS at the 80% threshold. Availability of latest technologies and university – industry collaboration in R&D have negative signs but only the former is significant at the 10% level for the 51% equity model. Host country firm technology absorption is not significant.

Tables 5 - 9 about here

A summary of our case analysis is shown in Appendix B. For BMW, in the low equity stakes in Kringlan (Switzerland) and ParkatmyHouse (UK) the company was in an explorative mode. Kringlan was a specialized materials producer, with on-going collaborations in various industries, including automotive. The opportunity for BMW was for composite wheels to replace steel wheels and reduce the weight of vehicles. The investment aimed to develop capability in a country where patents would be protected and where any risks due to the partner's collaboration with other companies could be minimized. ParkatmyHouse was a website aimed to match people wanting to rent out their driveways with drivers looking for a space to park, for a fee. The

ParkatmyHouse JV explored ways in which BMW could help them in developing the website for use in other markets, such as the US. Innovative mobility solutions with sustainability was a core focus. In the Kringlan and ParkatmyHouse investments, BMW valued the benefits of clustering and collaborations in R&D for exploring these new technological opportunities. With the Sauber investment in Switzerland, BMW aimed to use the JV as a testing ground for new technologies. However, Sauber had previously worked with various other engine manufacturers. The need to control the outcomes of R&D collaboration with Sauber encouraged the higher equity stake. While learning was clearly an important factor, there was more of an exploitative element to the investment compared with Kringlan and ParkatmyHouse, with return on investment expected in a shorter timeframe. The greater Zurich area, where Kringlan and Sauber were situated, has become a prominent knowledge-intensive cluster, particularly in ICT.

For Daimler, the low equity stakes in Icelandic New Energy (INE) (Iceland) and STARCAM (Czech Republic) were aimed at exploring new technological domains, although the STARCAM investment was more of an exploitative nature. INE was created following a host country government decision to find new ways to shift from fossil fuels in transport to hydrogen (technology that Daimler had used in its Citaro bus range). Iceland was at the forefront of alternative energy development. INE acted as a research body, as well as an advisor to government policies, a networking hub, university partner in joint research projects, applying its knowledge and network base also in the marine and aerospace industries. Iceland’s clusters did not comprise solely industries and institutions within its borders, they also spanned Nordic neighbors such as Denmark, Sweden and Norway. INE also coordinated another cluster - Græna Orkan (Ecoenergy) - having an even closer relationship with government stakeholders responsible for environmental reforms. In the case of STARCAM, the Czech Republic had pre-existing established automotive clusters (such the Moravian-Silesian Automotive Cluster) administered at Podnikatelský inkubátor VŠB-TU Ostrava (Technical University of Ostrava). STARCAM, however, was situated in Most, in the west of the country, closer to Germany, and was a manufacturer of aluminum components, including heads and engine blocks. Most had a large cluster of suppliers to the automotive industry, including glass producer AGC and tire manufacturer Continental. The majority control stake in STARCAM is consistent with an entry strategy to control proprietary assets given the presence of other automotive players in close proximity. In the case of MB SIM Tech (China) for Daimler, we see a greater exploitative element and a majority stake. MB SIM Tech had strong competences in vehicle design, powertrain and electronic solutions. Given China was set to become the 2nd biggest market for Daimler by 2020, the majority stake allowed the company to use knowledge and insights form that market to direct R&D activity.

For VW, TTTech Computertechnik (Austria) and Cummins-Scania high pressure injection (USA) investments, both low equity stakes, were highly explorative. TTTech was based in Vienna, a city with a strong cluster base for automotive R&D. The JV aimed to develop technology in driver safety, piloted driving and vehicle systems reliability. Austria had a world-class automotive technology industry, with, on average 1.4 patent applications submitted by the industry in Austria every day. However, TTTech was involved in a range of institutions and firms, not only in automotive, but also in other transportation and aerospace industries. In the minority stake in Cummins Scania (USA), VW had a mission to develop high pressure injection systems for Scania's engines and technology to increase engine efficiency. Clustering was not as important in this case as Cummins' pre-existing expertise and innovation output in this particular field. Having a sound IP protection regime to protect knowledge assets given the presence of all other global competitors in the host country was also important. The Mälardalens Teknikgymnasium (Sweden) majority stake arose as a consequence of VW's corporate acquisition of Scania and was a reflection of the corporate desire to exploit Scania's asset base. This investment was a higher education institution dedicated to preparing future Scania employees and offering R&D support to Scania. The Teknikgymnasium was within walking distance of numerous Scania R&D centers, demonstration and industrial entities in Södertälje. Scania stated that Mälardalens Teknikgymnasium ensured a stable influx of highly skilled labor, already knowledgeable of Scania's way of working. It enabled lower recruitment costs, made it faster to find workforce at a shorter notice, and ensured a stable "quality" of new recruits. Controlling this human capital supply system through a majority stake is consistent with the logic of protecting against knowledge loss and turnover of skilled staff to other companies in the host country.

Overall, the robustness tests support the findings in Tables 5 and 6. The statistical tests consistently give similar profiles of coefficients. The selected cases illustrate strategic imperatives for equity levels in foreign investments and show lower equity levels in more explorative investments, and higher equity levels in more exploitative ones. Furthermore, in the nine cases we examined, there was no suggestion of cultural distance or political stability being directly related to the ownership decision. GDP growth and market size appeared to matter for Daimler's majority stake in MB SIM Tech, but elsewhere these factors were not as important as the need to create new technological competence for the wider MNE by tapping into innovation outputs and clusters in host countries.

In summary, findings indicate that host country R&D determinants matter to internationalization strategy of technology-intensive MNEs, and they matter more so than factors traditionally used by scholars of MNE entry strategy. Furthermore, while different aspects of host country R&D will influence internationalization strategy in different ways, clustering emerges as the most consistent host country R&D determinant of ownership decisions made by the technology-intensive MNE.

6. Discussion

The present study was motivated by two observations. The first of these was the growing importance of globalized R&D as well as the prevalence of technology-intensive MNEs in the global economy. The second was that, despite extensive research on MNE internationalization, there is limited empirical work on how host country R&D influences MNE entry strategy. Host country R&D matters to entry strategy because of its importance as a source of learning for the MNE and as a source of assets that can be bundled with MNE assets (e.g., Hennart, 2009; Mutinelli and Piscitello, 1998). This is particularly salient for technology-intensive MNEs seeking to benefit from tacit and intangible location advantages (Meyer et al., 2009). Precisely *how* they matter in specific technology-intensive industries has not been established in prior research. While some entry strategy research has touched on the role played by host country R&D (Mutinelli and Piscitello, 1998), most influential research does not consider host country R&D determinants explicitly, focusing instead on institutions, firm and industry characteristics, and various distances and sources of uncertainty and risk (e.g., Berry et al., 2010; Chen and Hennart, 2002; Delios and Henisz, 2003; Dikova, and Van Witteloostuijn, 2007; Filatotchev et al., 2008; Gatignon and Anderson, 1988; Hennart and Larimo, 1998; López-Duarte and Vidal-Suárez, 2013; Makino and Neupert, 2000; Yiu and Makino, 2002). Entry strategy literature that does consider R&D does so from a firm-centric perspective, e.g., in terms of a firm's R&D intensity or asset specificity (Brouthers and Hennart, 2007; Canabal and White, 2008; Dikova, and Van Witteloostuijn, 2007) or as an intensity variable distributed unequally across subsidiaries (Cantwell and Mudambi, 2005). Our perspective differs as we consider host country R&D as part of the opportunity space in a specific industry. This opportunity space is multidimensional and its features differ by country.

Our analysis diverges from prior studies because we put an explicit focus on host-country R&D determinants of the ownership decision, and highlight how different aspects of host country R&D will be salient. Findings are reinforced through various tests that control for locational characteristics and different operationalization. Case examples illustrate the foreign engagement of our sample companies in R&D and these reinforce the patterns we find in regression models. Such case examples are not commonly shown alongside large sample models in the MNE entry strategy literature and we think these can help interpreting the results.

There are three sets of contributions from the analysis. Firstly, we add to literature on location advantages and how these matter in determining entry strategy of technology-intensive MNEs. We extend earlier work on location advantages that considered market size and uncertainties (Agarwal and Ramaswami, 1992; Brouthers and Hennart, 2007; Dunning, 1998, 2000), and highlight how host country R&D represents technological opportunity for foreign MNEs. Note the case examples in Appendix B in support of this. Host country technological opportunity has been somewhat neglected in entry strategy research in favor of firm-centric and risk-related characteristics of host countries. We put a more explicit focus on host country R&D determinants and show how these matter in different ways to the ownership aspect of entry strategy.

Secondly, the results show how institutional theory and resource-based explanations relate to entry strategy of technology-intensive MNEs in the modern era. In countries where innovation output and clustering are deemed location advantages, behavioral and contextual uncertainty are not as important to our understanding of MNE internationalization as institutional conformity and knowledge seeking logics. While this may reflect our focus on MNEs whose technology-intensity is indicative of high levels of proprietary knowledge, the fact that this knowledge may be put at risk in such host countries raises questions for transaction cost explanations of entry strategy. As indicated by the cases, international JVs by technology-intensive MNEs can be used to gain legitimacy, seek out new knowledge, and engage in explorative research. We see this very clearly in the Kringlan, ParkatmyHouse and Sauber investments for BMW, the INE and STARCAM investments for Daimler, and the TTTech Computertechnik and Cummins-Scania high pressure injection investments for VW. These partners all also collaborate with other institutions and firms in other industries (e.g., INE and TTTech), and some have had links with other competitors in the automotive industry (Sauber and STARCAM). Investing MNEs would appear to put the value of exploring new technological opportunities above the costs associated with behavioral concerns. In this sense our study of technology-intensive MNEs provides support to scholars (e.g., Mani et al., 2007) who find the influence of transaction cost considerations on ownership to be modest.

Thirdly, the study provides insight into internationalization in the automotive industry. Scholars have called for industry-specific samples in studies on MNE internationalization (Brouthers and Hennart, 2007). The automotive industry is a global one, increasingly driven by R&D in areas such as transmission, fuel cells, sensors, entertainment, communication, ADAS and autonomous driving (as well as related areas such as those shown in Appendix B). In our sample alone, nearly € 100 Billion was spent on R&D by the parent companies over an 8 year period. Findings provide reasons why MNEs in this industry seek JVs as they expand, despite their formidable firm-specific advantages in innovation. In this industry, we see the development of clustering and R&D collaborations in host countries influencing JV choice, and for choosing a lower equity stake within a JV. Innovation output and inward tech FDI into a host country also matter but to a lesser extent. Other R&D factors, such as technology absorption, have little impact on the ownership decision. Taken collectively, this is interesting because it shows us how this particular global industry is forward-thinking (i.e., has a 'future-orientation') in terms of how it sees location advantages in host countries. Examples that reinforce this point include Kringlan and ParkatmyHouse for BMW, INE and MB SIM Tech for Daimler and TTTech for VW. Host country clustering and R&D collaborations have future potential in the eyes of large, technology-intensive firms competing in this industry. Previously registered patents and innovation output that occurred in prior years represent efforts of the past: a 'past-orientation'. While these do matter, they may not reflect what firms believe could happen in the future by engaging in cluster-abundant environments through JVs.

Our study has a number of implications for managers and policy-makers in host countries seeking to attract inward FDI. For MNE managers, an appropriate level of equity for new overseas investments matters as the investment becomes an important source of learning and asset augmentation. Managers will need to understand the nature of the R&D environment in host countries as a part of this decision-making process. Findings also stress the need to develop partnering capabilities for JVs in countries where clustering and innovation networks are advanced. Partnering capability involves identifying and evaluating partners, negotiating and formalizing contracts, as well as the ongoing management of relationships in host countries. Knowledge management systems can be used by the MNE to capture and share knowledge as the company learns and explores through JVs. Mechanisms to rotate engineers and technicians between JV partners also will help with knowledge transfer; we see this in the case of BMW's investment in Sauber.

In terms of host country government policy, findings suggest conditions under which host countries can encourage foreign MNEs to seek JVs in their jurisdiction. Host countries may prefer to encourage JVs with foreign technology-intensive MNEs in order to boost the economy through spillover benefits. With high levels of clustering and R&D collaboration, and with proven innovation outputs, the host country is more likely to achieve this, even with foreign MNEs that traditionally had a tendency for WOS, such as in the automotive industry. Host country governments can provide reassurance on concerns that MNEs might have with JVs, by offering a set of location advantages based on R&D characteristics that helps the MNE to overcome any perceived risks.

The present study comes with a number of limitations, and also raises fresh research questions. In terms of limitations, firstly, the findings are limited to one home country and large, highly internationalized firms from one industry. We caution against generalizing to other countries and industries. Secondly, we did not look at establishment mode, the choice between acquisition and Greenfield, and we did not look at non-equity modes such as licensing and franchising. This may limit the interpretations in terms of wider implications for internationalization amidst globalized R&D. Thirdly, we were limited in terms of our use of indicators from secondary sources, including WIPO, World Bank and WEF sources. We could not tap into the depth of managerial and organizational dynamics for all investments. We also limited our focus to three areas of R&D characteristics in a host country: the country as a generator of innovation, as a domain for clustering, and as a recipient of inward FDI in technology. There are other dimensions of host country R&D that can be used in future work.

We believe MNE researchers should include host country R&D determinants more prominently, especially when researching industries where globalized R&D is important for competitive advantage. Researchers could note our findings that different dimensions of host country R&D will have different effects on entry strategy. A more nuanced approach going beyond rather top-level locational advantages is therefore needed, looking at innovation inputs and outputs, and future-oriented technological opportunities versus past-oriented innovation performance. Finally, we suggest future research could study the phenomenon of MNE entry strategy from the point of view of the host country R&D, examining the role played by government policy and R&D institutions on MNE investment using a range of indicators, including non-equity modes and the establishment mode choice. We hope these recommendations and the analysis in the present study will allow future work to provide greater insight into host country R&D determinants of MNE strategy.

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Table 1
Sample characteristics by MNE

MNE	Number of observations in sample (2005-2012)	Of which were IJVs (95% equity threshold)	Total R&D spend 2005-2012 (intensity - annualized 2005-2012)	Patents filed (total 2006-2012) (dpma.de)
BMW	58	12 (20.7%)	€ 27.95 Billion (5.5%)	4,597
Daimler	302	77 (25.5%)	€ 44.64 Billion (4.9%)	11,799
Volkswagen	964	50 (5.2%)	€ 25.31 Billion (4.6%)	4,980
Total	1324	139 (10.5%)	€ 97.90 Billion	21,376

Table 2
Host countries in the sample

Non-OECD (n=33)	OECD (n=32)
Albania, Argentina, Brazil, Bulgaria, China, Colombia, Costa Rica, Croatia, Dominican Republic, Guatemala, India, Indonesia, Iran, Jordan, Kenya, Latvia, Lithuania, Malaysia, Morocco, Pakistan, Panama, Peru, Philippines, Romania, Russia, Saudi Arabia, Serbia, Singapore, South Africa, Thailand, UAE, Ukraine, Uruguay	Australia, Austria, Belgium, Canada, Chile, Czech Republic, Denmark, Estonia, Finland, France, Greece, Hungary, Iceland, Ireland, Italy, Japan, Korea, Luxembourg, Mexico, Netherlands, New Zealand, Norway, Poland, Portugal, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey, UK, USA

Table 3
Data variables, measurements, definitions and sources

Variable / Type	Measurement	Definition	Source
Ownership mode / Dependent	1 = WOS 0 = JV	Parent firm's ownership arrangement in foreign direct investment: WOS = $\geq$95%; JV = <95%	DAX-listed car manufacturers yearly list of Investments per year
Population/Control	Log of host country population	The size of the host country's market in terms of its population	World Bank (http://data.worldbank.org/)
GDP per capita/Control	Log of gross domestic product/population	Economic development of host country	World Bank (http://data.worldbank.org/)
POLCON/Control	Political constraints in terms of the number of veto points.	Feasibility of a change in policy given the structure of a nation's political institutions	Henisz (2010)
Cultural distance/Control	Summed squares of the variance between host country and Germany	National cultural differences between a home and host country	Hofstede (1980); Kogut & Singh (1988)
Host experience	1 = prior recent investment 0 = no prior recent investment	MNE experience in the host country in a previous year within the dataset timeframe	DAX-listed car manufacturers yearly list of Investments per year
Innovation output / Independent	Natural log of total patent applications in a given year	National patenting intensity	World Intellectual Property Organization (http://www.wipo.int/ipstats/en/)
Clustering/ Independent	Item 11.03 in the Global Competitiveness Report	Extent to which well-developed and deep clusters are widespread (geographic concentrations of firms, suppliers, producers, institutions)	World Economic Forum, Executive Opinion Surveys (2005-2012)
Tech FDI / Independent	Item 9.03 in the Global Competitiveness Report	Extent to which FDI brings new technology into the host country	World Economic Forum, Executive Opinion Surveys (2005-2012)

Table 4
Correlations and descriptive information

	Mean	SD	1	2	3	4	5	6	7	8
1. Ownership mode	0.90	0.31								
2. Innovation output	9.21	2.06	-0.16***							
3. Clustering	4.36	0.67	-0.14***	0.44***						
4. Tech FDI	4.96	0.43	0.01	-0.11***	0.28***					
5. Population (ln)	17.55	1.50	-0.14***	0.87***	0.18***	-0.24***				
6. GDP per capita (ln)	10.11	0.94	0.02	-0.02	0.52***	0.28***	-0.38***			
7. POLCON	0.70	0.20	0.02	-0.19***	0.25***	0.27***	-0.37***	0.61***		
8. Cultural distance	1.37	0.96	0.07*	-0.19***	-0.31***	-0.12***	-0.09***	-0.44***	-0.47***	
9. Host experience	0.85	0.67	-0.02	0.12***	0.10***	-0.02	0.12***	0.04	0.10***	-0.08**

+p < 0.1; *p < 0.05; **p < 0.01; ***p < 0.001
N=1324

Table 5
LOGIT results (WOS=1, threshold 95%)

	Prediction	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Population (ln)		-0.13 (0.08)	0.16 (0.20)	0.05 (0.09)	-0.12 (0.08)	0.30 (0.21)	0.75* (0.31)
GDP per capita (ln)		-0.03 (0.14)	0.18 (0.19)	0.30+ (0.17)	-0.02 (0.14)	0.48* (0.21)	0.67* (0.34)
POLCON		0.74 (0.65)	0.69 (0.64)	1.03 (0.64)	0.62 (0.66)	0.76 (0.65)	2.14* (1.02)
Cultural Distance		0.17 (0.15)	0.19 (0.15)	0.21 (0.14)	0.17 (0.15)	0.21 (0.14)	0.43+ (0.23)
Year dummies (x 8)		Included	Included	Included	Included	Included	Included
Company dummies (x 3)		Included	Included	Included	Included	Included	2 dummies
Host experience		-0.22+ (0.13)	-0.22+ (0.12)	-0.20 (0.12)	-0.22+ (0.14)	-0.20+ (0.12)	-0.11 (0.41)
Innovation output (patents)	-		-0.20 (p=0.12) (0.13)			-0.15 (0.14)	**-0.41*** **(0.19)**
Clustering (state of development)	-			**-0.80***** **(0.22)**		**-0.85***** **(0.23)**	**-1.21***** **(0.38)**
Tech FDI (inward)	+				0.25 (0.27)	**0.53*** **(0.27)**	0.42 (0.45)
Constant		5.27* (2.40)	0.05 (4.15)	2.38 (2.50)	3.86 (2.82)	-4.55 (4.69)	-12.23 (7.50)
-2 log likelihood		749.33	747.06	735.94	748.48	731.54	342.78
Pseudo-R^2 (Nagelkerke)		0.21	0.21	0.22	0.21	0.23	0.23

+$p < 0.1$; *$p < 0.05$; **$p < 0.01$; ***$p < 0.001$
N=1324 except Model 6 (excluding VW) which has N=360

Table 6
TOBIT results for equity stake (right-censored at 95% equity)

	Prediction	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Population (ln)		-0.05 (0.03)	0.04 (0.08)	0.01 (0.03)	-0.04 (0.03)	0.07 (0.08)	0.24* (0.10)
GDP per capita (ln)		-0.00 (0.06)	0.06 (0.07)	0.10 (0.06)	-0.00 (0.06)	0.15* (0.08)	0.21+ (0.11)
POLCON		0.20 (0.25)	0.19 (0.26)	0.28 (0.23)	0.16 (0.25)	0.20 (0.24)	0.59+ (0.33)
Cultural Distance		0.05 (0.05)	0.06 (0.05)	0.06 (0.05)	0.05 (0.05)	0.06 (0.05)	0.11 (0.08)
Year dummies (x 8)		Included	Included	Included	Included	Included	Included
Company dummies (x 3)		Included	Included	Included	Included	Included	2 dummies
Host experience		-0.06** (0.02)	-0.06** (0.02)	-0.06** (0.02)	-0.06** (0.02)	-0.06** (0.02)	0.03 (0.13)
Innovation output (patents)	-		-0.06 (0.05)			-0.04 (0.05)	**-0.14*** **(0.06)**
Clustering (state of development)	-			**-0.25**** **(0.08)**		**-0.27***** **(0.08)**	**-0.36**** **(0.13)**
Tech FDI (inward)	+				0.08 (0.10)	**0.17+** **(0.10)**	0.10 (0.16)
Constant		2.96*** (0.91)	1.45 (1.52)	2.05* (0.92)	2.51 (1.07)	0.43 (1.46)	-2.76 (2.48)
Log pseudolikelihood		-398.83	-398.14	-393.80	-398.45	-392.07	-184.89
Pseudo R2		0.14	0.14	0.15	0.14	0.16	0.13

+$p < 0.1$; *$p < 0.05$; **$p < 0.01$; ***$p < 0.001$
139 uncensored observations except Model 6 (excluding VW) which has 89 uncensored observations

Table 7
LOGIT robustness tests (alternative proxies for independent variables) (WOS=1, threshold 95%)

	Prediction	Model 1	Model 2	Model 3	Model 4	Model 5
Population (ln)		-0.05 (0.08)	-0.06 (0.08)	-0.13 (0.08)	-0.04 (0.09)	0.06 (0.12)
GDP per capita (ln)		0.25 (0.19)	0.17 (0.17)	-0.04 (0.14)	0.29 (0.19)	0.36 (0.29)
POLCON		1.50* (0.73)	0.89 (0.65)	0.71 (0.65)	1.40+ (0.76)	2.34* (1.14)
Cultural Distance		0.23 (0.15)	0.20 (0.15)	0.17 (0.15)	0.23 (0.15)	0.34 (0.23)
Year dummies (x 8)		Included	Included	Included	Included	Included
Company dummies (x 3)		Included	Included	Included	Included	2 dummies
Host experience		-0.19 (0.12)	-0.20+ (0.12)	-0.22+ (0.13)	-0.19 (0.12)	0.01 (0.41)
Innovation output (latest technology)	-	**-0.48* (0.22)**			-0.45 (0.32)	-0.35 (0.45)
Clustering (univ. – industry collab.)	-		**-0.30+ (0.16)**		-0.15 (0.22)	**-0.66+ (0.39)**
Tech FDI (absorption)	+			0.03 (0.06)	0.13 (0.21)	0.06 (0.22)
Constant		4.17 (2.56)	3.42 (2.54)	5.26* (2.40)	2.60 (2.60)	0.18 (3.83)
-2 log likelihood		744.40	745.84	749.01	742.82	350.82
Pseudo-R^2 (Nagelkerke)		0.21	0.21	0.21	0.22	0.20

+p < 0.1; *p < 0.05; **p < 0.01; ***p < 0.001
N=1324 except Model 5 (excluding VW) which has N=360

Table 8
TOBIT robustness tests (alternative proxies for independent variables, right-censored at 95% equity)

	Prediction	Model 1	Model 2	Model 3	Model 4	Model 5
Population (ln)		-0.02 (0.03)	-0.03 (0.03)	-0.05 (0.03)	-0.02 (0.03)	0.02 (0.04)
GDP per capita (ln)		0.09 (0.07)	0.05 (0.06)	-0.004 (0.05)	0.10 (0.08)	0.11 (0.10)
POLCON		0.42 (0.26)	0.24 (0.24)	0.18 (0.24)	0.42 (0.29)	0.66 (0.42)
Cultural Distance		0.07 (0.05)	0.06 (0.05)	0.05 (0.05)	0.07 (0.05)	0.08 (0.08)
Year dummies (x 8)		Included	Included	Included	Included	Included
Company dummies (x 3)		Included	Included	Included	Included	2 dummies
Host experience		-0.06 (0.04)	-0.06 (0.04)	-0.06+ (0.03)	-0.06** (0.02)	0.04 (0.14)
Innovation output (latest technology)	-	**-0.15*** **(0.07)**			-0.18 (*p*=0.11) (0.11)	-0.12 (0.16)
Clustering (univ. – industry collab.)	-		-0.08 (*p*=0.16) (0.06)		-0.02 (0.08)	-0.20+ (0.12)
Tech FDI (absorption)	+			0.01 (0.02)	0.05 (0.04)	0.02 (0.02)
Constant		1.84* (0.94)	2.01* (0.95)	2.44** (0.90)	1.68+ (0.99)	1.18 (1.25)
Log pseudolikelihood		-396.90	-397.87	-398.63	-396.17	-188.38
Pseudo R2		0.15	0.14	0.14	0.15	0.11

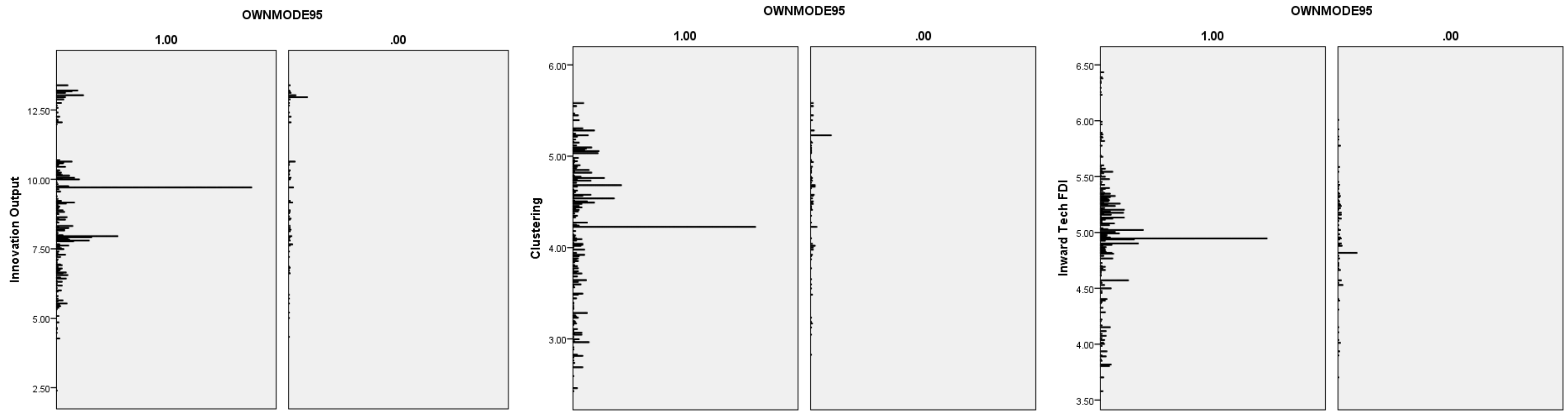
+$p < 0.1$; *$p < 0.05$; **$p < 0.01$; ***$p < 0.001$
139 uncensored observations except Model 6 (excluding VW) which has 89 uncensored observations

Table 9
LOGIT robustness tests (ownership mode at 51% and 80% equity threshold)

	Prediction	Model 1 51%	Model 2 80%	Model 3 51%	Model 4 80%
Population (ln)		0.30 (0.27)	0.33 (0.22)	-0.07 (0.10)	-0.07 (0.09)
GDP per capita (ln)		0.15 (0.28)	0.49* (0.22)	0.11 (0.25)	0.31 (0.20)
POLCON		1.69* (0.86)	0.39 (0.66)	2.92** (1.00)	1.02 (0.78)
Cultural Distance		0.29 (0.19)	0.14 (0.15)	0.37+ (0.20)	0.15 (0.15)
Year dummies (x 8)		Included	Included	Included	Included
Company dummies (x 3)		Included	Included	Included	Included
Host experience		-0.26* (0.12)	-0.23 (0.15)	-0.24* (0.12)	-0.22 (0.14)
Innovation output (patents)	-	-0.22 (0.17)	-0.22 (p=0.12) (0.14)		
Clustering (state of development)	-	**-0.65* (0.28)**	**-0.77*** (0.23)**		
Tech FDI (inward)	+	0.28 (0.36)	**0.46+ (0.28)**		
Innovation output (latest technology)	-			**-0.78+ (0.43)**	-0.42 (0.33)
Clustering (univ. – industry collab.)	-			-0.08 (0.27)	-0.25 (0.23)
Tech FDI (absorption)	+			0.10 (0.35)	0.12 (0.21)
Constant		-0.12 (0.36)	-4.26 (4.81)	6.40+ (3.31)	3.62 (2.71)
-2 log likelihood		536.68	706.13	537.32	713.84
Pseudo-R^2 (Nagelkerke)		0.22	0.22	0.21	0.21

+p < 0.1; *p < 0.05; **p < 0.01; ***p < 0.001
N=1324

Figure 1
Dot plots for host country innovation output, clustering and inward tech FDI by MNE ownership mode (WOS=1)



<u>Equality of means:</u>
Innovation Output: t=5.74 p<0.001, mean difference = 1.05
Clustering: t = 5.09, p<0.001, mean difference = 0.30
Inward Tech FDI: t = -0.47, not significant

APPENDIX A - Summary of predictions

Host Country R&D Characteristic	Institution-based Logic	Resource-based Logic	Prediction
Host country as a generator of innovation	High levels of patenting indicate strong institutions and reliable IP protection regimes. High levels of trust in governance quality mitigate risks of JVs. Normative institutions encouraging the MNE to engage in innovative activity with partners who have fresh ideas and different insights on how to solve problems.	Foreign technology-intensive MNEs can tap into the innovation outputs of the host country and it is appropriate to do this with exploratory, low equity modes. These will allow knowledge and intangible assets to flow into the MNE while mitigating commercial risk related to emerging technologies that are not yet commercialized.	JV over WOS Lower equity stake within any JV
Host country as a domain for clustering and R&D collaboration	Government policy promotes clusters and encourages them to be nurtured and upgraded. Legitimacy will be achieved for the MNE through adherence to the expectation that the MNE will participate in clusters on joint development. JVs are an indication of long-term commitment to collaboration.	Clusters provide localized agglomeration of resources through which JVs and lower equity stakes permit access. Evaluation of emerging technologies in clusters is achieved through closely working with partners jointly committed to developing new assets.	JV over WOS Lower equity stake within any JV
Host country as a recipient of inward technology FDI	Other MNEs from around the world diffuse their technology into the host country. To be legitimate the MNE should do the same (mimetic isomorphism) and the need to protect proprietary assets while doing this will mean a greater likelihood of WOS.	New technology entering the host country could be a threat to the MNE. Using a WOS for full control allows the MNE to protect its own assets and adopt a defensive position. If an MNE wanted to augment its asset base with technology from another MNE, it would not necessarily need to do this in a specific host country.	WOS over JV Higher equity stake within any JV

APPENDIX B – Interpreted relevance of host country R&D determinants in selected cases

MNE	Host Country	Investment / stake / opportunity	Exploration: innovation output	Exploration: clusters and collaboration	Exploitation and presence of inward tech FDI
BMW	Switzerland	Kringlan / 17.51% / access to composite material technology for application in car wheels	**	***	*
BMW	UK	ParkatmyHouse / 25.1% / access to app to for expanding mobility services	-	**	*
BMW	Switzerland	Sauber / 60% / component development for F1 cars + technology accelerator for entire company	**	***	**
Daimler	Iceland	Icelandic New Energy / 16.82% / shift from fossil fuels to alternative energy in transport	*	***	-
Daimler	Czech Republic	STARCAM / 51% / aluminium components for vehicles, including engine blocks	-	***	**
Daimler	China	MB SIM technology / 75% / R&D capabilities in vehicle design, powertrain and electronics	**	**	**
VW	Austria	TTTech / 24.99% / driver safety, piloted driving, vehicle-integrated computer systems reliability	***	***	-
VW	USA	Cummins-Scania high pressure injection / 30% / high pressure injection systems for Scania	***	*	*
VW	Sweden	Mälardalens Teknikgymnasium / 80% / supply of trained staff for Scania	-	**	***

Note: Indicators show our interpretation of the extent to which each of the host country R&D determinants influenced the investment location and stake: *** = highly relevant; **= moderately relevant; * = somewhat relevant; - = not relevant